APPENDIX A
CIVIL ENGINEERING DESIGN CRITERIA

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1.0 INTRODUCTION

Control of the design, engineering, procurement, and construction activities on the Project will be completed in accordance with various predetermined standard practices and project specific practices. An orderly sequence of events for the implementation of the Project is planned consisting of the following major activities:

- Conceptual design
- Licensing and permitting
- Detailed design
- Procurement
- Construction and construction management
- Startup, testing, and checkout
- Project completion

The purpose of this appendix is to summarize the codes and standards and standard design criteria and practices that will be used during the Project. The general foundation and civil engineering design criteria defined herein form the basis of the design for the foundation and civil systems of the Project. More specific design information will be developed during preliminary and detailed design to support equipment procurement and construction specifications. It is not the intent of this appendix to present the detailed design information for each component and system, but rather to summarize the codes, standards, and general criteria that will be used.

Section 2.0 summarizes the applicable codes, standards laws and ordinances and Section 3.0 includes the general criteria for foundations, design loads, and general site information.

2.0 DESIGN CODES, STANDARDS, LAWS AND ORDINANCES

The design and specification of work shall be in accordance with all applicable laws and regulations of the federal government, the State of California, and with the applicable local codes and ordinances. The following laws, ordinances, codes, and standards have been identified as applying to civil engineering design and construction.

When an edition date is not indicated the latest edition and addenda at time of plant design and construction shall apply.

2.1 FEDERAL

- Title 29, Code of Federal Regulations (CFR), Part 1910, Occupational Safety and Health Standards.

- Title 40, CFR Section 112 et seq., US Environmental Protection Agency (EPA), requires a Spill Prevention Control and Countermeasure (SPCC) plan of facilities storing oil in excess of 660 gallons in any single above ground storage tank; 1,320 gallons in aggregate tanks above ground; and 4,200 gallons below ground.

2.2 STATE

- Business and Professions Code Section 6704, et seq., Sections 6730 and 6736, requires state registration to practice as a Civil Engineer or Structural Engineer in California.

- Vehicle Code Section 35780, et seq., requires a permit from Caltrans to transport heavy loads on state roads.

- Labor Code Section 6500, et seq., requires a permit for construction of trenches or excavations 5 feet or deeper where personnel have to descend. This also applies to construction of any building, structure, false work or scaffolding which is more than three stories high or equivalent.

- Design will conform to the requirements of California Occupational Safety and Health Administration (CALOSHA).

- State of California Department of Transportation (Caltrans), Standard Specifications, July 1995.

- Title 24, California Administration Code (CAC) Section 2-111, et seq.; Sections 3-100, et seq.; Section 4-106, et seq.; Section 5-102, et seq.; Section 6-T8-769, et seq.; Section 6-T8-3233, et seq.; Section 6-T8-3270, et seq.; Section 6-T8-5138, et seq.; Section 6T8-5465, et seq.; Section 6-T8-5531, et seq.; and Section 6-T8-5545, et seq., adopts current edition of Uniform Building Code (UBC) as minimum legal building standards.

- Title 8, CAC, Section 1500, et seq.; Section 2300, et seq.; and Section 3200, et seq., describes general construction safety orders, industrial safety orders, and work safety requirements and procedures.

2.3 COUNTY

- Colusa County Code.

2.4 CODES AND INDUSTRY STANDARDS

The following general design requirements and procedures will be followed in development of project specifications regarding the use of Codes and Industry Standards.

- Specifications for materials will generally follow the standard specification for the American Society for Testing and Materials (ASTM) and the American National Standards Institute (ANSI).

- Field and laboratory testing procedures for materials will follow standard ASTM specifications.

- Design and placement of structural concrete will follow the recommended practices and the latest version of the American Concrete Institute Code (ACI) and the Concrete Reinforcing Steel Institute (CRSI).

- Welding procedures and qualifications for welders will follow the recommended practices and codes of the American Welding Society (AWS).

- Preparation of metal surfaces for coating systems will follow the specifications and standard practices of the Steel Structures Painting Council (SSPC), National Association for Corrosion Engineers (NACE) and the specific instructions of the coatings manufacturer.

- Plumbing will conform to the Uniform Plumbing Code (UPC).

The following Codes and Industry Standards shall be used:

- California Energy Commission (CEC). "Recommended Seismic Design Criteria for Non-Nuclear Generating Facilities in California"- June 1989.
- International Conference of Building officials. "Uniform Building Code" (UBC), 1997 Edition.
- California Building Code 1998 Edition.
- American Association of State Highway and Transportation Officials (AASHTO)-(1990), "A Policy on Geometric Design of Highways and Streets."
- Hydraulic Institute Standards, 14th Edition, 1983.
- American Water Works Association (AWWA).
- "Standards for Prestressed Concrete Pressure Pipe, Steel Cylinder Type for Water and Other Liquids"-(AWWA C301, 1992).
- "Standards for Reinforced Concrete Water Pipe-Noncylinder Type, Not Prestressed"-(AWWA C302, 1987).
- Asphalt Institute, Pacific Coast Division, Asphalt Institute Handbook, 1989 Edition.

3.0 CIVIL DESIGN CRITERIA

3.1 FOUNDATIONS

3.1.1 Geotechnical Investigation

The results of the preliminary geotechnical assessment prepared for this site are presented in Section 8.15, Colusa Power Plant Seismic Hazard Study, Geotechnical Information. The major geotechnical characteristics of the site include high to very high expansive soils with high settlement potential, and soils not subject to liquefaction. It is anticipated that the proposed structures, concrete slabs-on-grade and other improvements may be satisfactorily supported on shallow foundations after the expansive soils are removed and replaced with structural fill.

3.1.2 Foundation Design criteria

Detailed foundation design criteria, including allowable bearing pressures, settlement curves, dynamic soil properties and allowable pile loads will be developed based on the results of a detailed geotechnical investigation performed prior to the detailed design phase of the project.

3.2 DESIGN LOADS

Design loads for structures and equipment foundations are discussed in Appendix B. Design loads for pavements and buried items will be determined according to the criteria described below, unless the applicable building code requires more severe design conditions.

3.2.1 Wheel and Crawler Loads

Loads exerted on roadway pavements, buried piping, box culverts, and embankments will be reviewed and selected prior to design of the underlying items. Typically, AAHSTO HS20-44 truckloads will be

used for the design of roadways. Loading such as loaded scrapers, crawler cranes, equipment transport trailers, etc., may exceed the more typical HS20 loadings and will be considered where appropriate.

3.3 SITE

3.3.1 Site Arrangement

The site arrangement will conform to applicable laws, regulations, and environmental standards. The principle elements in the selection of site arrangement criteria are the physical space requirements and relationships dictated by each of the major plant systems. Distances between various systems will be minimized for economy. However, adequate clearance between various plant systems will be provided as needed for construction, operations, maintenance, and fire protection. The plant will be located and oriented to minimize costs of construction, while remaining operationally effective. Utility interconnections will be optimized as much as practical. Spill containment measures will be provided. Aqueous ammonia storage tank will be provided for the facility. Spill containment measures will be provided. Treatment systems will be provided for facility wastewater streams. Sanitary wastewater disposal system will be provided.

The facility access road and internal access roads will be provided. The site arrangement will be developed to minimize fill and/or excavation costs while maintaining efficiency of plant construction, operation, and maintenance. Area inlets will collect site storm water runoff to a storm drain system that discharges to a sedimentation/detention pond.

The following criteria will be followed regarding site infrastructure:

- Oil and chemical storage areas will be designed to contain spills.
- Culverts and sanitary sewer manholes will be installed as required.
- Location and requirements for fencing or walls will conform to the Colusa County Ordinances.

3.3.2 Site Preparation

Site preparation will consist of clearing and grubbing, removal of top soil, excavation and backfilling of soils to design grade, and the preparation of slopes and embankments designed to be stable and capable of carrying anticipated loads from either equipment or structures. Materials from clearing and grubbing operations will be removed from the site. Excavation and backfill will be balanced with on site material to the maximum extent possible.

3.3.3 Excavation and Fill

Excavation is performed for foundation construction, utility and pipe installation and storm drainage facilities and will conform to the grading drawings developed for the project.

Materials suitable for backfill will be stored in stockpiles at designated locations using proper erosion protection methods. Excavated material that meets the design requirements will be used as general site fill where possible. Other excess non-contaminated material will be removed from the site and disposed of at an acceptable location. Disposal of contaminated material if encountered during excavation will comply with all applicable federal, state, and local regulations.

Confined temporary excavations will be sloped or braced to prevent cave-ins during construction. All excavation and trenching operations will comply with local, state, and federal OSHA regulations.

Excavation and fill will be balanced with on site material to the maximum extent possible. Topsoil (upper 6-inch layer) will be stockpiled on site.

3.3.4 Grading and Embankments

Graded areas will be smooth, compacted, free from irregular surface changes, and sloped to drain.

Final earth grade adjacent to buildings will be at least 6 inches below finished floor slab and will be sloped away from the building to maintain proper drainage.

3.3.5 Backfilling and Compaction

Areas to be backfilled will be prepared by removing unsuitable material and rocks. The bottom of an excavation will be examined for loose or soft areas. Such areas will be excavated fully and backfilled with compacted fill. If available compacted fill material will be obtained from on site excavations. The material will be placed and compacted to the grades and density determined by the design.

Backfilling will be done in layers of uniform, specified thickness. Soil in each layer will be properly moistened to facilitate compaction to achieve the specified density. In order to verify compaction, representative field density and moisture-content tests will be taken during compaction.

Structural fill under and within five feet of the foundations, roads, parking areas, etc., will be compacted to at least 95 percent of the maximum dry density as determined by ASTM D1557. Embankments, dikes, bedding for buried piping, and backfill surrounding structures will be compacted to a minimum of 90 percent of the maximum dry density. General backfill placed in remote and/or unsurfaced areas will be compacted to at least 85 percent of the maximum dry density.

Where fills are to be placed on subgrades sloped at 6:1 (horizontal: vertical) or greater, keys into the existing subgrade may be provided to help withstand horizontal seismic ground accelerations.

The subgrade (original ground), subbases, and base courses of roads will be prepared and compacted in accordance with California Department of Transportation (Caltrans) requirements. Testing will be in accordance with ASTM and Caltrans standards.

Approximately 6 inches of topsoil will be placed on fill in any areas that are to be seeded or otherwise landscaped.

3.3.6 Site Drainage

The site drainage system will be designed to comply with all applicable federal, state, and local regulations. The general site grading will establish a working surface for construction and plant operating areas, provide positive drainage from buildings and structures, and provide adequate soil coverage for underground utilities.

On site drainage will be accomplished through gravity flow whenever possible. The surface drainage system will consist of mild slopes. The buildings and structures will be located at a minimum ground floor elevation of 6 inches above the finished grade. The preferred slope of the graded areas away from

structures will be 2 percent with a minimum slope of 1 percent. A storm sewer system with inlets and underground pipes will be provided in areas where or trenches not feasible.

Site drainage facilities will be designed to prevent flooding of permanent plant facilities resulting from a 10-year, 24-hour rainfall, as defined by US Bureau Technical Paper No. 40, without flooding roads and the 50-year storm event without flooding plant facilities and equipment, unless local code requirements govern.

Temporary facilities will be designed for a 2-year rainfall. In addition, no permanent facilities will be located within the 100-year flood plain. The main plant area will be graded with moderate slopes (1 percent minimum preferred) for effective drainage.

Runoff from possible oil and chemical contamination areas, such as transformer areas and chemical storage areas, will be contained. Storm water contained in these areas will be routed through an oil/water separator and a wastewater collection system to the zero liquid discharge system for recovery and reuse.

Culverts and ditches will be installed to ensure positive drainage.

The facility property will be preserved undisturbed where practical. Impact on wetlands will be minimized.

3.3.6.1 Drainage Ditches

Drainage ditches will generally be trapezoidal in section, of sufficient width to facilitate cleaning, and mildly sloping so that erosion of the ditch bottom due to high flow velocities is minimized. Side slopes will be approximately two horizontal to one vertical. The preferred slope of the ditch bottom will be 100 horizontal to one vertical, with a minimum slope of 200 horizontal to one vertical. In areas where space is limited and design flow rates are small, ditches having a triangular cross section will be provided. In areas where the ditches may be crossed by vehicles, the ditch depth and slope will be as gentle as possible.

Drainage ditches will be designed to convey the 10-year, 24-hour rainfall runoff flow without producing a headwater elevation above the bottom of the roadway base course. Erosion protection for ditches will be provided by grassed surfaces except in areas where peak runoff velocities will be greater than 4 feet per second (fps). These ditches will be protected by erosion control fabric, riprap, concrete paving, or soil-cement.

3.3.6.2 Drainage Culverts

Drainage culverts will be provided at the intersection of ditches and embankments. Culverts will be constructed of reinforced concrete pipe or corrugated metal pipe. Reinforced concrete box culverts will be provided where necessary.

The drainage culverts and associated ditches will be designed to ensure passage of the 10-year, 24-hour rainfall runoff flow without producing a headwater elevation above the bottom of the roadway base course. The minimum cover requirement of culverts will be 12 inches. All culverts will be designed to handle AASHTO HS20 truckloads or Copper E80 railroad loads and construction equipment loadings as applicable to the design. Allowance for corrosion protection over the expected life of the plant will be accounted for in the design and selection of culvert materials. Culverts will have beveled end sections compatible with the ditch side slopes or concrete headwalls at both the inlet and outlet. The inlets and outlets of all culverts will be protected from erosion by the installation of riprap.

3.3.6.3 Storm Sewer System

Storm water runoff will be collected on site and drained via plant drainage system to a sedimentation/detention pond. Inlets will be constructed of cast-in-place or pre-cast concrete with top grates. Storm sewer pipes will be sized to limit flow velocities resulting from the 10-year, 24-hour rainfall event to a maximum of 8 fps. A minimum design velocity of 2 fps will be used to facilitate cleaning. The minimum cover requirement, loading, and material selection for pipes will be as specified for culverts.

The detention pond will be an earth-diked structure. The pond will be designed to detain the difference in runoff before-construction (pre-development) and after-construction (post-development) conditions.

3.3.6.4 Pre and Post-Development Runoff Conditions

The peak runoff associated with the 10-year storm event at the site, before-construction (pre-development), will be compared to the after-construction (post-development) conditions. It is anticipated that it will be slightly less than the post-development runoff condition. The outflow from the detention pond will be designed not to exceed the peak runoff of the pre-development condition.

3.3.7 Erosion and Sedimentation Control

Erosion and sedimentation control will be provided to retain sediment on site and to prevent violations of water quality standards.

The proposed site development will slightly alter the land areas of the site. Existing, sparse vegetation will be removed as required during site preparation. The general preparation of the overall site will be followed by earthmoving activities required for the construction of the plant. Final finish grading will begin when all other grading operations are complete. Final grading may include seeding disturbed areas not occupied by plant facilities or surfaced with concrete, asphalt or crushed aggregate.

Temporary erosion and sedimentation control measures to be used during construction will be designed to prevent sediments from being displaced and carried off-site by storm water runoff.

Prior to beginning excavation activities, a silt fence or straw bales will be installed along the perimeter of the project site where runoff to off-site areas could occur. The silt fence will filter sediments from construction runoff. During construction, the extent of earth disturbances will be minimized as much as practical.

Diversion ditches and/or berms will be constructed as necessary to divert runoff from off-site areas around the construction site. Temporary control measures will be maintained as necessary throughout the construction period.

Permanent erosion and sedimentation control measures within the project plant site will include the runoff collection system (ditches, inlets, culverts, drainage piping) and sedimentation/detention pond, surfaced traffic and work areas, and seeded non-working areas.

3.3.8 Roads

Access to the plant will be via Delavan Road, McDermott Road, and Dirks Road. The roads will be appropriately maintained during the construction period. Periodic watering or applications of a dust palliative material will be used to minimize dust problems. Vehicular traffic into and out of the site will be limited as much as practical to daylight hours on Monday through Friday.

3.3.9 Fencing and Security

Chain link security fencing will be provided around the power plant facility site, switchyard, and other areas requiring controlled access. Fencing heights will be in accordance with applicable codes, regulatory requirements, and owner preference. A controlled access gate will be located at the main entrance to the secured area.

3.3.10 Wetlands

Wetlands will be avoided wherever practicable. Where necessary and feasible, the location of a structure, facility and/or transmission line alignment will be done to eliminate or reduce the wetland impacts.

3.3.11 Landscape Plan

There is currently no plan to landscape the site. However, should landscaping be ultimately required it will be planned as follows:

- The landscape plan will rely on site topography.

- All landscape material used will be selected with due consideration for the climatic and soil conditions on the site. The theme for the planting plan will be derived from an assessment of naturally occurring plant materials and an evaluation of the need for dense, hardy screening. Areas within the facility boundary not occupied or finish surfaced, will be seeded.

3.3.12 Sanitary Waste System

The sanitary waste system will be connected to a septic tank with leachfield. The design will conform to the Colusa County regulations and Uniform Plumbing Code. The total quantity of flow used in sizing the sanitary waste system will be calculated based on the total equivalent fixture units provided. Pipe will be sloped to provide a 2.5 fps minimum velocity, half full. Minimum slope for main sewer pipe will be 1.0 percent.